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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the wide viewing angle polarizing plate which can form a liquid crystal display with a wide viewing angle range of right visual recognition in detail about a wide viewing angle polarizing plate. In this invention, the thickness of a phase difference plate d, the direction of a lagging axis of a phase difference plate, phase leading shaft orientations, Each refractive index of a thickness direction shall be expressed with n_e, n_o, and n_Z, respectively, and with the phase contrast within a field. Formula : (n_e-n_o) Are the quantity defined by d and with N_Z. Formula : (n_e-n_Z) Are the quantity defined by / (n_e-n_o) and with an intersected [perpendicularly] type. The lagging axis of a phase difference plate means the axial arrangement type which is at least in a rectangular cross to the absorption axis of light polarizer, and a parallel type means the axial arrangement type which has a lagging axis of a phase difference plate in parallel grade to the absorption axis of light polarizer.
[0002]
[Description of the Prior Art]Can link a liquid crystal display directly with IC with the low voltage and low power consumption, and its display function is various, and And a weight saving, Since it has many features -- a miniaturization is easy and there is -- it has spread widely as various displaying means, such as OA equipment, such as a word processor and a personal computer, television, a car navigation monitor, and a monitor for airplane cockpits.
[0003]The polarizing plate is used in order to make a liquid crystal display visualize change of the orientation of a liquid crystal. A polarizing plate laminates a transparent protective film (TAC) to light polarizer, and is usually constituted. Light polarizer divides incident light into two polarization components which intersect perpendicularly mutually, and is the optical element which makes it pass only on the other hand (ingredient with a vibrating direction parallel to the transmission axis of light polarizer), and absorbs or distributes other ingredients (ingredient with a vibrating direction parallel to the absorption axis of light polarizer).
[0004]A transmission type liquid crystal display comprises the both sides of the thickness direction to a polarizing plate on both sides of a liquid crystal cell. As for the light polarizer of both sides, it is common to make a mutual transmission axis intersect perpendicularly and to be arranged. One pair of light polarizers which made the transmission axis intersect perpendicularly are called rectangular light polarizer. Generally, there is visual angle dependency in the characteristic of light polarizer, and if light enters from an oblique

direction to light polarizer as shown in drawing 6, the direction of a transmission axis will change. Therefore, even if it piles up the 1st and 2nd light polarizer 1 and 2 to vertical-incidence light so that each transmission axes 1T and 2T may intersect perpendicularly mutually, To oblique-incidence light, intersecting angles shift from a right angle, it has an ingredient of a direction parallel to the transmission axis 2T, this ingredient passes the 2nd light polarizer 2, and the polarization which passed the 1st light polarizer 1 produces a light leak.

[0005]The visual angle dependency of such light polarizer becomes a cause which narrows the viewing angle range (angle of visibility) which can recognize visually well the luminosity of the screen of a liquid crystal display, contrast, tone, etc. In order to realize a liquid crystal display with a large angle of visibility, development of the polarizing plate which made large the viewing angle range (angle of visibility) which reduces the visual angle dependency of light polarizer and a light leak hardly produces, i.e., a wide viewing angle polarizing plate, is indispensable, and the thing of when is proposed until now.

[0006]Any wide viewing angle polarizing plate piles up light polarizer and the phase difference plate of 1-2 sheets, and is constituted. The definitional equation showing the double refraction property of refractive-index different direction objects, such as a phase difference plate and a liquid crystal, of many variables is shown in drawing 7. The conventional example 1 shown in drawing 8 the optically uniaxial phase difference plates 10 and 11 called A plate and C plate (a definition is referring to drawing 7) to the 1st light polarizer 1, The former lagging axis 10S is at least in a rectangular cross to the transmission axis 1T of the 1st light polarizer, and it is laminated and constituted so that the latter lagging axis 11S may turn to a film thickness direction (J. Chenet al:SID'98 Digest (1998), p315). The phase contrast within a field of the A plate 10 and the phase contrast of the thickness direction of the C plate 11 are 137 nm and 80 nm, respectively. The polarization condition of the light which passed the 1st light polarizer can be changed in the direction which intersects perpendicularly with the transmission axis of the 2nd light polarizer by this, and the visual angle dependency of rectangular light polarizer can be reduced substantially.

[0007]However, in the conventional example 1, since it differs the case where the direction of the polarization which enters into a liquid crystal layer is vertical incidence, and in the case of oblique incidence, in the case of a reflection type liquid crystal display, there is a problem from which the optical property of the medium (a liquid crystal and a phase difference plate) inserted into light polarizer changes a lot. Also in the case of a transmission type, since wavelength dependency is large, there is a problem that the leakage of light will arise (refer to drawing 13).

[0008]The conventional example 2 shown in drawing 9 is what made the lagging axis 10S vertical to the absorption axis 1A of the light polarizer 1, and laminated the A plate 10 which has field inboard phase contrast:350nm in the light polarizer 1 (made by NITTO DENKO CORP.). The conventional example 3 shown in drawing 10 TAC3 of the 1 side of the polarizing plate which has TAC3 on both sides of the light polarizer 1, or both sides, Phase contrast within a field: It was considered as the phase difference plate 12 of 50-200 nm, N_Z:-1 - 3, and the absorption axis 1A of the light polarizer 1 and the lagging axis 12S were made to be parallel or cross at right angles (JP,9-325216,A).

[0009]The conventional example 4 shown in drawing 11 is what made the transmission axis 1T of the light polarizer 1, and the lagging axis 12S be parallel or cross at right angles in one side of the light polarizer 1, and has arranged the phase difference plate 12 of phase contrast:50-200nm, N_Z:-1 - 3 in a field in it (JP,10-

48420,A). The conventional example 5 shown in drawing 12 in less than thickness direction phase contrast:300nm and a field in one side of the light polarizer 1 The phase difference plate 12A not more than phase contrast:20nm, Phase contrast within a field: It is what made the transmission axis 1T of the light polarizer 1, and lagging-axis 12BS of the phase difference plate 12B be parallel or cross at right angles, and has arranged the phase difference plate 12B of 50-200 nm, N_Z:0.8 - 3.5 (JP,10-142423,A).

[0010]However, according to this invention persons' theoretical calculation, also in the conventional examples 2-5, there is the same problem as the conventional example 1.

[0011]

[Problem(s) to be Solved by the Invention]An example is taken by the problem of said conventional technology, and this invention has the work which makes equal to the time of vertical incidence the polarization condition of the light which passed the light polarizer at the time of oblique incidence, can compensate change of the optical property of a liquid crystal, and an object of this invention is to provide the wide viewing angle polarizing plate which can realize a liquid crystal display with a large angle of visibility.

[0012]

[Means for Solving the Problem]In order that this invention persons may attain said purpose, a theoretical-model type describes a necessary condition for a polarization condition to become equal in the time of vertical incidence and oblique incidence, A designing method of adopting what searches for the double refraction property of a phase difference plate which fulfills this necessary condition at the various given degrees of incidence angle, among those shows small transmissivity in a wide viewing angle range was originated, the optimal characteristics of a phase difference plate were extracted based on this designing method, and this invention was completed.

[0013]That is, this inventions are the following wide viewing angle polarizing plates and liquid crystal displays of a passage.

(1) In an intersected [perpendicularly] type polarizing plate which becomes light polarizer in piles about an optically biaxial phase difference plate, A wide viewing angle polarizing plate in which said phase difference plate is characterized by phase contrast =250 within field - 300 nm, N_Z=0.1 - 0.4, and having phase contrast =260 within field - 290 nm, N_Z=0.2 - 0.3, and the becoming double refraction property more preferably.

[0014](2) In a parallel type polarizing plate which becomes light polarizer in piles about an optically biaxial phase difference plate, A wide viewing angle polarizing plate in which said phase difference plate is characterized by phase contrast =250 within field - 300 nm, N_Z=0.6 - 1.1, and having phase contrast =260 within field - 290 nm, N_Z=0.7 - 1.0, and the becoming double refraction property more preferably.

A wide viewing angle polarizing plate which is a wide viewing angle polarizing plate which is on a phase difference plate side of a wide viewing angle polarizing plate of (3) and (1) in piles about a phase difference plate of (2), or is on a phase difference plate side of a wide viewing angle polarizing plate of (2) in piles about a phase difference plate of (1), and is characterized by a lagging axis of an adjacent phase difference plate being mutually parallel.

[0015](4) A liquid crystal display a whole surface side of a liquid crystal cell having the structure where facing arrangement of the wide viewing angle polarizing plate of (1) or (2) was carried out to near either or both by the phase difference plate side on the other hand.

(5) A liquid crystal display of (4) which is [said wide viewing angle polarizing plate are is an intersected / perpendicularly / type in either of near / the other] a parallel type on the other hand as for a whole surface side of said liquid crystal cell.

[0016](6) A liquid crystal display a whole surface side of a liquid crystal cell having the structure where facing arrangement of the wide viewing angle polarizing plate of (3) was carried out to either of near by the phase difference plate side on the other hand.

[0017]

[Embodiment of the Invention]Drawing 1 (a) and (b) is an explanatory view showing the composition of the wide viewing angle polarizing plate of this invention (1) and (2). This is constituted in piles by the light polarizer (POL) 1 in the optically biaxial phase difference plate (what PF1 requires for this invention (1) and PF2 requires for this invention (2), respectively) 12. In this invention, the transparent protective film (TAC) 3 may be arranged at the reverse phase reference board side of a wide viewing angle polarizing plate (it is below the same). In this invention, as shown, for example in drawing 14, as a film which reinforces a protective film or intensity at one side or the both sides of the light polarizer 1 or the phase difference plate 12, The transparent film (for example, 5 nm or less) (it is called an optical-isotropy transparent membrane) 13 which is not based on the angle into which light enters unlike TAC, and does not (almost) have phase contrast may be arranged (it is below the same). The effect that the polarizing plate of this composition is also the same is acquired. As a raw material of said optical-isotropy transparent membrane, polyether sulphone (Polyether sulfone ;P ES.), a glass sheet, etc. can use preferably, for example.

[0018]In this invention (1), the light polarizer 1 and the axial arrangement type of phase difference plate PF1 are intersected [perpendicularly] types, and phase difference plate PF1, phase contrast =250 within field - 300 nm (preferably 260 - 290 nm), and N_Z=0.1 -0.4 (preferably 0.2-0.3) -- it is formed so that it may have double refraction property. In this invention (2), the light polarizer 1 and the axial arrangement type of phase difference plate PF2 are parallel types, and phase difference plate PF2, phase contrast =250 within field - 300 nm (preferably 260 - 290 nm), and N_Z=0.6 -1.1 (preferably 0.7-1.0) -- it is formed so that it may have double refraction property.

[0019]Drawing 1 (c) and (d) is an explanatory view showing the composition of the wide viewing angle polarizing plate of this invention (3). What (drawing 1 (c)) was piled up so that this might become parallel [the mutual lagging axis 12S] about phase difference plate PF2 of this invention (2) at the phase difference plate PF1 side of the wide viewing angle polarizing plate of this invention (1), Or it is what (drawing 1 (d)) put phase difference plate PF1 of this invention (1) on the phase difference plate PF2 side of the wide viewing angle polarizing plate of this invention (2) so that the mutual lagging axis 12S might become parallel.

[0020]By this composition, it can migrate to a wide viewing angle range, the polarization condition at the time of oblique incidence can be changed into the almost same state as the time of vertical incidence, and a light leak can be controlled. Said designing method made into the antecedent basis is explained below. In order to make the polarization condition at the time of oblique incidence equal to the time of vertical incidence, the conditions which the optical property of a phase difference plate should fulfill are following two.

[0021]1. change of the direction of the optic axis of the phase difference plate at the time of being [the phase contrast at the time of oblique incidence / pi] 2. oblique incidence is a half of light polarizer -- when a theoretical formula describes these 2 conditions, be as follows. A phase difference plate means a lagging

axis and an optic axis means an absorption axis with light polarizer. How to take incidence angle $theta_i$ of the direction phi of the optic axis at the time of vertical incidence and incident light is shown in drawing 2. Here, the direction of 45 degrees and an absorption axis was made into -45 degree for the direction of the lagging axis in $theta_i$=0 degree (vertical incidence).

[0022]The conditions 1 are described first. The phase contrast gamma of a phase difference plate is given with a following formula.

gamma=(k_{ez}-k_{oz}) d k_{oz} and k_{ez} are Z axial components of the wave number vector of the phase leading shaft orientations of incident light, and the direction of a lagging axis, respectively, and are given here (1-1) with a following formula.

[0023]

[Equation 1]

$$k_{oz}=\frac{2\pi}{\lambda}\,n_o\sqrt{1-\left(\frac{1}{n_o^2}+\frac{1}{n_z^2}\right)n^2\sin^2\theta_i} \qquad (1\text{-}2)$$

$$k_{ez}=\frac{2\pi}{\lambda}\,n_e\sqrt{1-\left(\frac{1}{n_e^2}+\frac{1}{n_z^2}\right)n^2\sin^2\theta_i} \qquad (1\text{-}3)$$

λ：光の波長，n：空気の屈折率，θ_i：光の入射角度

[0024]In order to fulfill the conditions 1 here, the value of a formula (1-1) should just be set to pi. Then, it is expressed with a following formula when it asks for the relation of thickness [at this time] (thickness) d, refractive-index n_e, n_o, and n_Z.

[0025]

[Equation 2]

$$n_e=\sqrt{\frac{\left(\frac{\pi}{d}+k_{oz}\right)^2+k_b^2}{\left(\frac{2\pi}{\lambda}\right)^2-\left(\frac{k_d}{n_z}\right)^2}} \qquad (1\text{-}4)$$

ここに、k_b，k_d は次式で与えられる。

$$k_b=\pm\frac{2\pi}{\lambda}\,n\sin\theta_i\sin\frac{\pi}{4} \qquad (1\text{-}5)$$

（複号±は、＋が平行型、－が直交型）

$$k_d=\frac{2\pi}{\lambda}\,n\sin\theta_i\cos\frac{\pi}{4} \qquad (1\text{-}6)$$

[0026]By designing the refractive index of an optically biaxial phase difference plate fill this expression of

relations (1-4), the conditions 1 can always be fulfilled. Next, the conditions 2 are described. Gap phi_{dp} (degree) of the optic axis of the light polarizer at the time of oblique incidence can be expressed with a following formula.

[0027]

[Equation 3]

$$\phi_{dp} = -\frac{180}{\pi} \arccos\left[\frac{k_{ozp}\cos\frac{\pi}{4}}{\sqrt{k_{ozp}^2 + \left(\alpha \sin\frac{\pi}{4}\right)^2}}\right] + 45 \qquad (2\text{-}1)$$

$$k_{ozp} = \frac{2\pi}{\lambda}\sqrt{n_{op}^2 - n^2 \sin\theta_i} \qquad (2\text{-}2)$$

$$\alpha = \frac{2\pi}{\lambda} n \sin\theta_i \cos\theta_a \qquad (2\text{-}3)$$

ここに、n_{op}：偏光子の吸収軸方向の屈折率，θ_a：光の入射方位，

α：入射光波数ベクトルのx軸成分

[0028]On the other hand, gap phi_{df} (degree) of the optic axis of a phase difference plate can be expressed with a following formula.

[0029]

[Equation 4]

$$\phi_{df} = -\frac{180}{\pi}\arccos\left[\frac{\pm\frac{k_c}{N_c}\sin\frac{\pi}{4} + \frac{k_b}{N_b}\cos\frac{\pi}{4}}{\sqrt{\sum_{j=a,b,c}\left(\frac{k_j}{N_j}\right)^2}}\right] + (90\pm45) \qquad (2\text{-}4)$$

(複号±は、+が直交型、−が平行型)

$$N_a = (n\sin\theta_i)^2 + \left(\frac{\lambda}{2\pi}k_{oz}\right)^2 - n_z^2 \qquad (2\text{-}5)$$

$$N_b = (n\sin\theta_i)^2 + \left(\frac{\lambda}{2\pi}k_{oz}\right)^2 - n_o^2 \qquad (2\text{-}6)$$

$$N_c = (n\sin\theta_i)^2 + \left(\frac{\lambda}{2\pi}k_{oz}\right)^2 - n_e^2 \qquad (2\text{-}7)$$

$$k_a = -k_{oz} \qquad (2\text{-}8)$$

$$k_c = k_a \qquad (2\text{-}9)$$

[0030]Therefore, a following formula should just be filled in order to fulfill the conditions 2. phi_{df}/phi_{dp}=0.5 (2-10) and double refraction property (relation of the thickness d, refractive-index n_e, n_o, and n_Z) which fills a formula (1-4) and (2-10) with time change by incidence angle $theta_i$. Then, lambda was taken in median of 550 nm of the visible light wavelength range of 400-700 nm, and double refraction property (relation of d, n_e, n_o, and n_Z) with which a formula (1-4) and a formula (2-10) are simultaneously filled to an incidence angle was searched for by convergence calculation. An incidence angle corresponding to double refraction property searched for in this way is called a design angle.

[0031]And the viewing-angle (equivalent to incidence angle) dependency of transmissivity in lambda= 550 nm was calculated about a model which infixed in rectangular light polarizer a phase difference plate which gave double refraction property corresponding to various design angles. A following formula was used for calculation of the transmissivity T.

$T=\sin^2$ (pi gamma/lambda) It turned out (3), as a result that there is a difference somewhat with the design angle theta as shown, for example in drawing 3, but it becomes below transmissivity 0.1 % by a case of every theta in 0-80 degrees of viewing angle ranges. Incidentally transmissivity of the conventional light polarizer is about about 2 to 4%. that is, by using a phase difference plate which has the double refraction property with which a formula (1-4) and a formula (2-10) are filled simultaneously showed that it was markedly alike rather than before, and a wide viewing angle polarizing plate with few light leaks was obtained.

[0032]When compared with the conventional thing in quest of the wavelength dependency of transmissivity, as shown, for example in drawing 13, a wide viewing angle polarizing plate of this invention had wavelength dependency smaller than the conventional thing, and it turned out that leakage of light can be prevented in

the wider wavelength range. An optimum range of double refraction property was specified with the above designing methods, and it was considered as a gist of this invention.

[0033]A phase difference plate which has the double refraction property specified in this way fulfills the aforementioned conditions 1 and the conditions 2 inevitably. So, according to this invention which laminated this phase difference plate to light polarizer, and constituted a polarizing plate, a wide viewing angle polarizing plate which can recognize good contrast visually over a wide viewing angle range is obtained. thickness d of a phase difference plate -- general -- 5 - 500 mum -- above all -- 10 - 350 mum -- it is especially considered as thickness of 20 - 200 mum.

[0034]As said light polarizer, a proper thing which can obtain light of a predetermined polarization condition can be used. What can obtain the transmitted light of a linear polarization state above all is preferred. As the example, a polyvinyl alcohol system film and a partial formal-ized polyvinyl alcohol system film, What iodine and/or dichromatic dye were made to stick to a hydrophilic high polymer film like an ethylene-vinyl acetate copolymer system partial saponification film, and was extended, A polarization film etc. which consist of a polyene oriented film like a dehydrating treatment thing of polyvinyl alcohol or a demineralization acid treatment thing of polyvinyl chloride, etc. are raised.

[0035]As said phase difference plate, a proper thing which has the birefringence by which conditions specified by this invention are fulfilled can be used. What gave birefringence for a proper film of a light transmittance state by stretching treatment etc. above all, a thing to which an orienting film of a liquid crystal polymer or orienting film superiors of a substrate were made to carry out orientation of the anisotropic materials, such as a liquid crystal polymer, etc. can use preferably. That for which light transmittance gave birefringence preferably to a film which is especially more preferably excellent in not less than 85% of translucency not less than 80% not less than 70% is preferred.

[0036]As the aforementioned translucency film, polycarbonate and polyarylate, Polysulfone, polyethylene rente REFUTATO and polyether sulphone, and polyvinyl alcohol, Especially a film that consists of polyethylene thru/or polyolefine like polypropylene and cellulose type polymer, polystyrene, polymethylmethacrylate and polyvinyl chloride, a polyvinylidene chloride, polyamide, etc. is preferred.

[0037]Proper methods, such as uniaxial-stretching processing, biaxial-stretching processing, etc. by the free end or a fixed end, can perform orientation treatment which gives birefringence to a translucency film, for example. Said TAC can be suitably formed as a coating layer of a plastic, laminated material of a protective film, etc., and a plastic etc. which are excellent in transparency, a mechanical strength and thermal stability, moisture cover nature, etc. can use it for the formation preferably. As the example, heat-hardened types, such as polyester system resin, acetate system resin, polyether sulphone acid system resin and polycarbonate system resin or acrylic and a urethane system, an acrylic urethane system, an epoxy system, and a silicone series, thru/or ultraviolet curing type resin, etc. are raised. As for TAC, the surface may be formed in fine rugged structure by content of particles.

[0038]Although a wide viewing angle polarizing plate of this invention can be preferably used for compensation of a visual angle characteristic by a double reflex of a liquid crystal cell, a method and a method with a beforehand proper method using it as laminated material etc. which laminate a phase difference plate and light polarizer separately one by one by a manufacturing process of a liquid crystal display can perform the formation. There are an advantage etc. in which the latter prior lamination method is excellent in stability and lamination workability of quality, raises manufacturing efficiency of a liquid crystal

display, and deals.

[0039]On the occasion of lamination arrangement of a phase difference plate to one side of light polarizer, etc., it is carried out so that an absorption axis of the light polarizer and a lagging axis of a phase difference plate may serve as a rectangular cross or parallel relationship, but the rectangular cross or parallel relationship is not limited to a rectangular cross or a parallel condition in a strict meaning, but arrangement errors on work are permitted. When there is variation in the direction of an absorption axis or a lagging axis, based on the average direction as the whole, it is arranged at a rectangular cross or parallel relationship.

[0040]When laminating light polarizer and a phase difference plate, it is fixable via adhesives etc. if needed. It is preferred to carry out adhesion fixing from points, such as gap prevention of an axial relation. Proper adhesives, such as transparent pressure sensitive adhesives, such as acrylic, a silicone series, a polyester system and a polyurethane system, a polyether system, and a rubber system, can be used for adhesion, for example, and there is no limitation in particular in it about the kind. From a point of preventing change of an optical property etc., what does not require a hot process in the case of hardening or desiccation is preferred, and what does not require prolonged curing treatment or a drying process is desirable. What does not produce exfoliation etc. under heating or a humidification condition is preferred.

[0041]From this point, average molecular weight used as an ingredient a monomer like butyl acrylate (meta), methyl acrylate (meta) and ethyl acrylate (meta), or acrylic acid (meta) or more by 100,000. An acrylic pressure sensitive adhesive with which glass transition temperature consists of 0 ** or less of acrylic polymer can use preferably especially. An acrylic pressure sensitive adhesive is preferred also from a point of excelling in transparency, weatherability, heat resistance, etc.

[0042]Proper additive agents, such as a filler, paints and colorant which consist of the resin of a natural product or a compound, glass fiber, a glass bead and a metal powder, other inorganic powder, etc. if needed, and an antioxidant, can also be blended with adhesives. It can also be considered as an adhesives layer which makes particles contain and shows light diffusibility. Each class, such as the above-mentioned light polarizer, a phase difference plate, TAC, and an adhesives layer, For example, an ultraviolet absorption function can also be given with a method etc. which are processed with ultraviolet ray absorbents, such as a salicylate system compound, a benzo phenol system compound, a benzotriazol system compound, a cyanoacrylate system compound, and a nickel complex salt system compound.

[0043]This invention (1) A usual method may be sufficient as a method of forming a liquid crystal display of this invention using a wide viewing angle polarizing plate concerning - (3). Namely, although a liquid crystal display is formed by assembling suitably component parts, such as a liquid crystal cell, light polarizer, a phase difference plate aiming at optical compensation, and a lighting system as occasion demands, and generally incorporating a drive circuit etc., There is no limitation in particular except for a point as for which a whole surface side of a liquid crystal cell, on the other hand, arranges the wide viewing angle polarizing plate concerned to near either or both in this invention.

[0044]Therefore, proper liquid crystal displays, such as a liquid crystal display which has arranged a wide viewing angle polarizing plate on one side or both sides of a liquid crystal cell, and a thing which used a back light or a light reflector for a lighting system, can be formed. Laminate integration of the formation part article of a liquid crystal display may be carried out, and it may be in a separation state. When forming a liquid crystal display, proper optical elements, such as a diffusion board, an anti glare layer and an antireflection film, a protective layer, a guard plate, a light filter, can be arranged suitably, for example. A wide viewing

angle polarizing plate of this invention is VA (vertical alignment). It can use for various displays, such as a TFT type, an MIM type, etc. using a liquid crystal cell which shows double reflexes, such as type and an IPS (inch-plane-switching) mold, preferably.

[0045]Drawing 4 is an explanatory view showing an example of a liquid crystal display of this invention (4) - (5). This is what used a wide viewing angle polarizing plate of this invention (1) - (2), and can respond to any mold of a reflection type and a transmission type. In a reflection type, there are two sorts shown in drawing 4 (a) and (b). On the other hand, this carries out facing arrangement of the wide viewing angle polarizing plate (a:rectangular-cross type, b: parallel type) of this invention (1) - (2) to either of near by the phase difference plate 12 side, and a whole surface side of the liquid crystal cell (LC) 4 has the structure which has arranged the light reflector (RP) 5 on the other.

[0046]In a transmission type, there are four sorts shown in drawing 4 (c) - (f). As for this, a whole surface side of LC4 has the structure which, on the other hand, carried out facing arrangement of the wide viewing angle polarizing plate of this invention (1) - (2) to near both by the phase difference plate 12 side. Axial arrangement types of a wide viewing angle polarizing plate are the whole surface side of LC4, and the thing (c:rectangular-cross type, d: parallel type) same on the other hand at a side, and, on the other hand, (e) and (f) are [(c) and (d) / whole surface side] different from each other by a side.

[0047]Since (e) in which an axial arrangement type of a wide viewing angle polarizing plate is [whole surface side of LC4] different by a side on the other hand, and (f) and (a thing which fills => this invention (5)) show the characteristic better than others, it is more preferred in four transmission type sorts. Drawing 5 is an explanatory view showing an example of a liquid crystal display of this invention (6). When this is made into a reflection type, light passes a phase difference plate a total of 4 times in an outward trip and a return trip, and stops suiting its design condition (=> light passes a phase difference plate twice) made into a premise of this invention, since the wide viewing angle polarizing plate concerned contains two phase difference plates using a wide viewing angle polarizing plate of this invention (3). Therefore, this invention (6) can respond only to a transmission type.

[0048]Drawing 5 (a) arranges the phase difference plate (PF2, PF1) 12 of two sheets, and the light polarizer (POL) 1 in this order at the whole surface side of the liquid crystal cell (LC) 4, presupposes mutually that it is parallel and, as for the lagging axis 12S of PF1 and PF2, shows a transmission type liquid crystal display of LC4 for which POL2 has been arranged to a side on the other hand. A set of "POL/PF1/PF2" corresponds to a wide viewing angle polarizing plate of this invention (3).

[0049]Drawing 5 (b) arranges the phase difference plate (PF1, PF2) 12 of two sheets, and the light polarizer (POL) 1 in this order at the whole surface side of the liquid crystal cell (LC) 4, presupposes mutually that it is parallel and, as for the lagging axis 12S of PF1 and PF2, shows a transmission type liquid crystal display of LC4 for which POL2 has been arranged to a side on the other hand. A set of "POL/PF2/PF1" corresponds to a wide viewing angle polarizing plate of this invention (3).

[0050]Although a thing of the cross Nicol (absorption axis of light polarizer pair which sandwiches liquid crystal cell intersects perpendicularly mutually) mold was illustrated as a transmission type liquid crystal display in drawing 4 (c) - (f) and drawing 5, This invention (4) - (6) is not limited to this but can be applied also to a thing of a parallel nicols (absorption axis of light polarizer pair which sandwiches liquid crystal cell is mutually parallel) mold.

[0051]

[Example]In the transmission type liquid crystal display which has the structure shown in drawing 4 (c) and (d), The liquid crystal cell was made into the dark condition about the example which changed the plane anisotropy and N_Z of the phase difference plate variously as shown in Table 1, and the example which does not use a phase difference plate, the visual angle dependency of transmissivity (light leak grade) was calculated about the visible light of wavelength lambda=550 nm, and the result was compared. The liquid crystal cell was used as VA type, and the cell thickness was taken as 5.2 mum.

[0052]As evaluation quantity of an angle of visibility, 0.30% of the 1st and 2nd threshold and 0.02% were provided in transmissivity, and transmissivity adopted the viewing angle range (2nd angle-of-visibility alpha$_2$) which showed the viewing angle range (1st angle-of-visibility alpha$_1$) which showed below the 1st threshold, and below the 2nd threshold. The result is shown in Table 1.

[0053]

[Table 1]

No	軸配置型	波長 nm	d μm	設計角度 deg.	面内*1位相差 nm	N_z *2	α_1 *3 deg.	α_2 *4 deg.	備考
1	位相差板なし	550	–	–	–	–	±30	±15	比較例
2	直交型	550	100	60	200	0.50	±31	±15	比較例
3	直交型	550	100	25	275	0.25	±80	±63	実施例
4	直交型	550	100	45	273	0.26	±80	±69	実施例
5	直交型	550	100	60	269	0.27	±80	±80	実施例
6	直交型	550	100	80	265	0.28	±80	±80	実施例
7	直交型	550	100	25	274	0.27	±80	±57	実施例
8	直交型	550	100	45	272	0.28	±80	±64	実施例
9	直交型	550	100	60	268	0.29	±80	±76	実施例
10	直交型	550	100	80	262	0.31	±80	±44	実施例
11	直交型	550	100	25	275	0.24	±70	±71	実施例
12	直交型	550	100	45	273	0.24	±80	±76	実施例
13	直交型	550	100	60	270	0.24	±80	±80	実施例
14	直交型	550	100	80	266	0.25	±80	±80	実施例
15	平行型	550	100	25	275	0.77	±57	±41	実施例
16	平行型	550	100	45	273	0.88	±67	±53	実施例
17	平行型	550	100	60	270	0.89	±80	±22	実施例
18	平行型	550	100	80	265	0.95	±80	±17	実施例
19	平行型	550	100	25	275	0.75	±56	±40	実施例
20	平行型	550	100	45	272	0.81	±66	±53	実施例
21	平行型	550	100	60	268	0.86	±80	±21	実施例
22	平行型	550	100	80	263	0.93	±80	±17	実施例
23	平行型	550	100	25	275	0.79	±58	±41	実施例
24	平行型	550	100	45	273	0.84	±68	±53	実施例
25	平行型	550	100	60	270	0.90	±80	±23	実施例
26	平行型	550	100	80	266	0.96	±80	±18	実施例

*1 $(n_e-n_o)d$ *2 $(n_e-n_z)/(n_e-n_o)$
*3 第1の視野角（透過率≦0.3%） *4 第2の視野角（透過率≦0.02%）

[0054]as shown in Table 1, the result that the 1st and 2nd angle of visibility was markedly alike, and large compared with what is not filled with what fills this invention (comparative example) was obtained.

[0055]

[Effect of the Invention]In this way, according to this invention, the polarization condition at the time of oblique incidence becomes equal to the time of vertical incidence, change of the optical property of a liquid crystal can be compensated, and the outstanding effect that a liquid crystal display with a large angle of

visibility embodies is done so.

[Translation done.]